

## Andreas Colliander

Dr. Andreas Colliander is a Research Scientist in the Water and Carbon Cycles Group of the Science Division. His primary field of research is the development of microwave remote sensing techniques. He is currently mainly focused on NASA's SMAP (Soil Moisture Active and Passive) mission as a member of the science algorithm development team. His work addresses calibration and validation of the soil moisture, freeze/thaw and net ecosystem exchange products of the mission. Additionally, he is funded by NASA to study calibration issues of European Space Agency's SMOS (Soil Moisture and Ocean Salinity) mission.



Dr. Colliander is a Senior Member of the IEEE, and serves as a co-lead of the Microwave Radiometer Working Group of the IEEE Geoscience and Remote Sensing Society.

---

### Education

- Ph.D., Electrical Engineering, Helsinki University of Technology (2007)
- M.S., Electrical Engineering, Helsinki University of Technology (2002)

---

### Research interests

Microwave remote sensing techniques, in particular for hydrology applications.

---

### Projects

#### **SMAP - Soil Moisture Active & Passive**

SMAP will provide global measurements of soil moisture and its freeze/thaw state.

---

### Professional Experience

- Jet Propulsion Laboratory, California Institute of Technology (2008 - Present)
  - Research Scientist, Surface Hydrology Group
- European Space Agency, European Space and Technology Research Centre (ESTEC), The Netherlands (2007-2008)
  - Postdoctoral Research Fellow
- Aalto University (formerly Helsinki University of Technology), Laboratory of Space Technology, Finland (2001-2007)
  - Research Scientist and Project Manager

## Book Chapters

**Colliander, A.**, "Calibration and Validation", Encyclopedia of Remote Sensing, E. G. Njoku (ed.). Springer, 2014. ISBN: 0387367004.

## Peer-Reviewed Publications

1. **Colliander, A.**, E.G. Njoku, T.J. Jackson, S. Chazanoff, H. McNairn, J. Powers, M.H. Cosh, "Retrieving soil moisture for non-forested areas using PALS radiometer measurements in SMAPVEX12 field campaign," Remote Sensing of Environment, Vol. 184, pp. 86-100, 2016.
2. Chan, S.K., R. Bindlish, P.E. O'Neill, E.G. Njoku, T.J. Jackson, **A. Colliander**, et al., "Assessment of the SMAP Passive Soil Moisture Product," IEEE Transactions on Geoscience and Remote Sensing, Vol. 54, No. 8, pp. 2016.
3. Chen, F., W.T. Crow, M. H. Cosh, **A. Colliander**, et al., Application of Triple Collocation in Ground-Based Validation of Soil Moisture Active/Passive (SMAP) Level 2 Data Products, IEEE Journal on Selected Topics in Applied Earth Observation and Remote Sensing, Early Access, 2016.
4. Xu, X., Derksen, C., Yueh, S.H., Dunbar, R.S., **Colliander, A.**, "Freeze/Thaw Detection and Validation Using Aquarius' L-Band Backscattering Data," IEEE Journal on Selected Topics in Applied Earth Observation and Remote Sensing, Vol. 9, No. 4, pp. 1370-1381, 2016.
5. Leroux, D. J., Das, N. D., Entekhabi, D., **Colliander, A.**, Njoku, E. G., Jackson, T., Yueh, S., "Active-Passive Soil Moisture Retrievals During the SMAP Validation Experiment 2012," IEEE Geoscience and Remote Sensing Letters, Vol. 13, No. 4, pp. 475-479, 2016.
6. Aksoy, M., Johnson, J. T., Misra, S., **Colliander, A.**, O'Dwyer, I., "L-Band Radio-Frequency Interference Observations During the SMAP Validation Experiment 2012," IEEE Transactions on Geoscience and Remote Sensing, Early Access, 2015.
7. Manns, H. R., Berg, A. A., **Colliander, A.**, Soil Organic Carbon as a Factor in Passive Microwave Retrievals of Soil Water Content over Grain Fields, Journal of Hydrology, Vol. 528, pp. 643-651, 2015.
8. **Colliander, A.**, Dinnat, E., Le Vine, D., Chae, C-S., Kainulainen, J., "Assessing Long Term Stability of SMOS Zero-Baseline Antenna Temperature using the Aquarius Antenna Temperature Simulator", IEEE Geoscience and Remote Sensing Letters, Vol. 12, No. 8, August 2015.
9. **Colliander, A.**, Jackson, T., McNairn, H., Chazanoff, S., Dinardo, S., Latham, B., O'Dwyer, I., Chun, W., Yueh, S., Njoku, E., "Comparison of Airborne Passive and Active L-band System (PALS) Brightness Temperature Measurements to SMOS Observations during the SMAP Validation Experiment 2012 (SMAPVEX12)," IEEE Geoscience Remote Sensing Letters, Vol. 12, No. 4, April 2015.
10. McNairn, H., Jackson, T., Wiseman, G., Belair, S., Berg, A., Bullock, P., **Colliander, A.**, Cosh, M., Kim, S., Magagi, R., Moghaddam, M., Adams, J., Homayouni, S., Ojo, E., Rowlandson, T., Shang, J., Goita, K., Hosseini, M., "The Soil Moisture Active Passive Validation Experiment 2012 (SMAPVEX12): Pre-Launch Calibration and Validation of the SMAP Satellite", IEEE Transactions on Geoscience and Remote Sensing, Vol. 53, No. 5, May 2015.
11. Martens, B., Lievens, H., **Colliander, A.**, Jackson, T., Verhoest, N. E. C., "Estimating effective roughness parameters of the L-MEB model for soil moisture retrievals from passive microwave observations", IEEE Transactions on Geoscience and Remote Sensing, Vol. 53, No. 7, July 2015.

12. Das, N., Entekhabi, D., Njoku, E., Shi, J., Johnson, J., **Colliander, A.**, "Tests of the SMAP Combined Radar and Radiometer Algorithm Using Airborne Field Campaign Observations and Simulated Data", *IEEE Transactions on Geoscience and Remote Sensing*, Vol. 52, No. 4, April 2014.
13. Das, N. N., **Colliander, A.**, Chan, S. K., Njoku, E. G., Li, L., "Intercomparisons of Brightness Temperature Observations Over Land From AMSR-E and WindSat," *IEEE Transactions on Geoscience and Remote Sensing*, Vol. 52, No. 1, January 2014.
14. **Colliander, A.**, Xu, X., "Normalized Residual Scattering Index Applied to Aquarius L-band Measurements", *IEEE Geoscience and Remote Sensing Letter*, vol. 10, no. 4, July 2013.
15. Magagi, R., Berg, A., Goïta, K., Belair, S., Jackson, T., Toth, B., Walker, A., McNairn, H., O'Neill, P., Moghaddam, M., Gherboudj, I., **Colliander, A.**, Cosh, M., Belanger, J., Burgin, M., Fisher, J. B., Kim, S-B., B.-Rousseau, L-P., Djamaï, N., Shang, J., Merzouki A., "Canadian Experiment for Soil Moisture in 2010 (CanEX-SM10): Overview and Preliminary Results", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 51, no. 1, January 2013.
16. **Colliander, A.**, "Analysis of Coincident L-Band Radiometer and Radar Measurements With Respect to Soil Moisture and Vegetation Conditions", *European Journal of Remote Sensing*, vol. 45, pp. 111-120, 2012.
17. **Colliander, A.**, Chan, S., Kim, S., Das, N., Yueh, S., Cosh, M., Bindlish, R., Jackson, T., Njoku, E., "Long Term Analysis of PALS Soil Moisture Campaign Measurements for Global Soil Moisture Algorithm Development", *Remote Sensing of Environment*, vol. 121, pp. 309-322, 2012.
18. **Colliander, A.**, McDonald, K., Zimmermann, R., Schroeder, R., Kimball, J., Njoku, E., "Application of QuikSCAT Backscatter to SMAP Validation Planning: Freeze/Thaw State over ALECTRA Sites in Alaska from 2000 to 2007", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 50, no. 2, February 2012.
19. Kainulainen, J., **Colliander, A.**, Close, J., Martin-Neira, M., Oliva, R., Buenadicha, G., Rubiales Alcaine, P., Hakkarainen, A., Hallikainen, M. T., "Radiometric Performance of the SMOS Reference Radiometers - Assessment After One Year of Operation", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 50, no. 5, May 2012.
20. **Colliander, A.**, Närhi, T., de Maagt, P., "Modeling and Analysis of Polarimetric Synthetic Aperture Interferometric Radiometers Using Noise Waves", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 48, no. 9, September 2010.
21. **Colliander, A.**, Martin-Neira, M., Closa, J., Benito, J., "Pre-Launch Estimation of Radiometric Resolution and Stability of SMOS Zero-Baseline Radiometer in Anechoic Chamber", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 48, no. 3, March 2010.
22. Kainulainen, J., Lemmetyinen, J., Rautiainen, K., **Colliander, A.**, Uusitalo, J., Lahtinen, J., "Error Propagation in Calibration Networks of Synthetic Aperture Radiometers", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 47, no. 9, September 2009.
23. **Colliander, A.**, Corbella, I., Torres, F., "Correlation Denormalization in Interferometric or Polarimetric Radiometers: A Unified Approach", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 47, no. 2, pp. 561-568, February 2009.
24. Brown, M., Corbella, I., Torres, F., **Colliander, A.**, "SMOS Calibration", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 46, no. 3, pp. 646-658, March 2008.
25. **Colliander, A.**, Ylä-Oijala, P., "Electromagnetic Scattering from Rough Surface Using Single Integral Equation and Adaptive Integral Method", *IEEE Transactions on Antennas and Propagation*, vol. 55, no. 12, pp. 3639-3646, December 2007

26. Lemmetyinen, J., Uusitalo, J., Kainulainen, J., Rautiainen, K., Fabritius, N., Levander, M., Kangas, V., Greus, H., Pihlflyckt, J., Kontu, A., Kemppainen, S., **Colliander, A.**, Hallikainen, M.T., Lahtinen, J., "SMOS Calibration Subsystem", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 45, no. 11, pp. 3691-3700, November 2007
27. **Colliander, A.**, Ruokokoski, L., Suomela, J., Veijola, K., Kettunen, J., Kangas, V., Aalto, A., Levander, A., Greus, H., Hallikainen, M., Lahtinen, J., "Development and Calibration of SMOS Reference Radiometer", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 45, no. 7, pp. 1967-1977, July 2007
28. **Colliander, A.**, Lahtinen, J., Tauriainen, S., Pihlflyckt, J., Lemmetyinen, J., Hallikainen, M., "Sensitivity of Airborne 36.5-GHz Polarimetric Radiometer's Wind-Speed Measurement to Incidence Angle", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 45, no. 7, pp. 2122-2129, July 2007.
29. **Colliander, A.**, Kettunen, J., Hallikainen, M. T., "Calibration of End-to-end Phase Imbalance of Polarimetric Radiometers", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 44, no. 10, pp. 2635-2641, Oct. 2006.
30. Corbella, I., Torres, F., Camps, A., Duffo, N., Vall-Ilossera, M., Rautiainen, K., Martín-Neira, M., **Colliander, A.**, "Analysis of Correlation and Total Power Radiometer Front-Ends Using Noise Waves" , *IEEE Transactions on Geoscience and Remote Sensing*, vol. 43, no. 11, pp. 2452-2459, Nov 2005.
31. **Colliander, A.**, Tauriainen, S., Auer, T., Kainulainen, J., Uusitalo, J., Toikka, M., Hallikainen, M., "MIRAS Reference Radiometer: A Fully Polarimetric Noise Injection Radiometer", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 43, no. 5, pp. 1135-1143, May 2005.
32. Corbella, I., Torres, F., Camps, A., **Colliander, A.**, Martín-Neira, M., Ribó, S., Rautiainen, K., Duffo, N., Vall-Ilossera, M., "MIRAS End-to-End Calibration. Application to SMOS L1 Processor", *IEEE Transactions on Geoscience and Remote Sensing*, vol. 43, no. 5, pp. 1126-1134, May 2005.

## Articles in International Conference Proceedings

1. **Colliander, A.**, Kainulainen, J., Dinnat, E., Chae, C-S., Torres, F., Corbella, I., Oliva, R., Martin-Neira, M., "Advances in Calibration of the SMOS Zero-Baseline Radiometers," 13<sup>th</sup> Specialist Meeting on Microwave Radiometry and Remote Sensing of the Environment, Pasadena, California, March 24-27, 2014.
2. **Colliander, A.**, et al., "Airborne Active and Passive L-band Measurements using PALS Instrument in SMAPVEX12 Soil Moisture Field Campaign", SPIE Asia-Pacific Remote Sensing, SPIE Asia-Pacific Remote Sensing 2012, Kyoto, Japan, October 29 - November 1, 2012.
3. **Colliander, A.**, Dinnat, E., Le Vine, D., Kainulainen, J., "Synthesizing SMOS Zero-Baseline with Aquarius Brightness Temperature Simulator", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2012, Munich, Germany, July 22-27, 2012.
4. **Colliander, A.**, McDonald, K., Zimmermann, R., Podest, E., Schroeder, R. Kimball, J., Njoku, E., "Active and Passive Multi-Scale Microwave Remote Sensing of the Alaska Ecological Transect: Application to SMAP Freeze/Thaw State Validation Planning", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2011, Vancouver, Canada, July 24-20, 2011.
5. **Colliander, A.**, McKague, D., "Interferometric Synthetic Aperture Microwave Radiometers: An Overview", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2011, Vancouver, Canada, July 24-20, 2011.
6. Bindlish, R., Jackson, T., Zhao, T., Cosh, M., Chan, S., O'Neill, P., Njoku, E., **Colliander, A.**, Kerr, Y., Shi, J. C., "Evaluation of SMAP Level 2 Soil Moisture Algorithms using SMOS Data", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2011, Vancouver, Canada, July 24-20, 2011.
7. **Colliander, A.**, McDonald, K., Zimmermann, R., Linke, T., Schroeder, R., Kimball, J., "QuikSCAT Backscatter Sensitivity to Landscape Freeze/Thaw State over ALECTRA Sites in Alaska from 2000 to 2007: Application to SMAP Validation Planning", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2010, Honolulu, Hawaii, USA, July 25-30, 2010.
8. **Colliander, A.**, Kim, S., Yueh, S., Cosh, M., Jackson, T., Njoku, E., "Azimuthal Signature of Coincidental Brightness Temperature and Normalized Radar Cross-section Obtained Using Airborne PALS Instrument", Progress in Electromagnetics Research Symposium PIERS 2010, Cambridge, MA, USA, July 5-8, 2010.
9. **Colliander, A.**, Chan, S., Yueh, S., Cosh, M., Bindlish, R., Jackson, T., Njoku, E., "Utilization of Airborne and In Situ Data Obtained in SGP99, SMEX02, CLASIC and SMAPVEX08 Field Campaigns for SMAP Soil Moisture Algorithm Development and Validation", MicroRad 2010 - 11<sup>th</sup> Specialist Meeting on Microwave Radiometry and Remote Sensing for the Environment, Washington D.C, USA, March 1-4, 2010.
10. Kainulainen, J., **Colliander, A.**, "In-orbit performance of the SMOS reference radiometers - results from the early commissioning phase", MicroRad 2010 - 11<sup>th</sup> Specialist Meeting on Microwave Radiometry and Remote Sensing for the Environment, Washington D.C, USA, March 1-4, 2010.
11. **Colliander, A.**, Martin-Neira, M., Closa, J., Benito, J., "Satellite radiometer pre-launch sensitivity estimation using anechoic chamber and channel inter-comparison", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2009, Cape Town, South-Africa, July 12-17, 2009.
12. Kangas, V., **Colliander, A.**, "Receiver as a Radiometer Calibration Target", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2009, Cape Town, South-Africa, July 12-17, 2009.

13. Kangas, V., **Colliander, A.**, "Use of Receiver as a Calibration Target", Microwave Technology and Techniques Workshop 2008, ESA/ESTEC, Noordwijk, The Netherlands, May 5-6, 2008.
14. **Colliander, A.**, de Maagt, P., Närhi, T., "Polarimetric Interferometric Radiometers: Analysis of Front-end Non-idealities", MicroRad 2008 - 10<sup>th</sup> Specialist Meeting on Microwave Radiometry and Remote Sensing for the Environment, Florence, Italy, March 11-14, 2008
15. **Colliander, A.**, Lemmetyinen, J., Uusitalo, J., Suomela, J., Veijola, K., Kontu, A., Kempainen, S., Pihlflyckt, J., Rautiainen, K., Hallikainen, M., Lahtinen, J., "Ground Calibration of SMOS: NIR and CAS", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2007, Barcelona, Spain, July 23-27, 2007
16. Christensen, J., Carlström, A., Ekström, H., Emrich, A., Embretsen, J., de Maagt, P., **Colliander, A.**, "GAS: the Geostationary Atmospheric Sounder", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2007, Barcelona, Spain, July 23-27, 2007
17. Kempainen, S., Lemmetyinen, J., Auer, T., **Colliander, A.**, Aalto, A., Rautiainen, K., Hallikainen, M., "Thermal Stabilized Front-end PCB with Active Cold Calibration Load for L-band Radiometer", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2007, Barcelona, Spain, July 23-27, 2007
18. Lahtinen, J., Piironen, P., **Colliander, A.**, Martin-Neira, M., "Improved Receiver Architecture for Future L-Band Radiometer Missions", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2007, Barcelona, Spain, July 23-27, 2007
19. **Colliander, A.**, Ruokokoski, L., Suomela, J., Veijola, K., Kettunen, J., Kangas, V., Levander, M., Greus, H., Hallikainen, M., Lahtinen, J., "Reference Radiometer of SMOS: Development and Calibration", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2006, Denver, Colorado, USA, July 31-August 4, 2006
20. **Colliander, A.**, Suomela, J., Veijola, K., Kettunen, J., Ruokokoski, L., Kangas, V., Lahtinen, J., Hallikainen, M., "Ground Calibration of Flight Models of Reference Radiometer of MIRAS", MicroRad 2006 - 9<sup>th</sup> Specialist Meeting on Microwave Radiometry and Remote Sensing for the Environment, San Juan, Puerto Rico, February 28-March 3, 2006
21. **Colliander, A.**, Suomela, J., Ruokokoski, L., Kangas, V., Aalto, A., Lahtinen, J., Hallikainen, M., "Temperature Variation Compensation in Engineering Model of MIRAS Reference Radiometer", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2005, Seoul, South-Korea, July 25-29, 2005
22. **Colliander, A.**, Lahtinen, J., Tauriainen, S., Pihlflyckt, J., Lemmetyinen, J., Hallikainen, M., "Airborne Ocean Wind Vector Measurement using 36.5 GHz Profiling Polarimetric Radiometer", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2005, Seoul, South-Korea, July 25-29, 2005
23. Kettunen, J., **Colliander, A.**, Hallikainen, M., "Linearly Polarized Antenna Load for Calibration of End-to-End Phase Difference of Polarimetric Radiometer Receivers", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2005, Seoul, South-Korea, July 25-29, 2005
24. Lahtinen, J., Ruokokoski, L., **Colliander, A.**, Kangas, V., Aalto, A., Levander, M., Greus, H., "Reference Radiometer for Interferometric Radiometry from Space", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2005, Seoul, South-Korea, July 25-29, 2005
25. **Colliander, A.**, Tauriainen, S., Auer, T., Uusitalo, J., Toikka, M., Hallikainen, M., "Evaluation of In-orbit Temperature Variation on Performance of MIRAS Prototype Noise Injection Radiometer", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2004, Anchorage, Alaska, USA, September 20-24, 2004

26. **Colliander, A.**, Ylä-Oijala, P., Pulliainen, J., "Electromagnetic Scattering from Ocean Surface Using Single Integral Equation and Adaptive Integral Method", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2004, Anchorage, Alaska, USA, September 20-24, 2004
27. Corbella, I., Torres, F., Camps, A., Duffo N., Vall-Ilossera M, Rautiainen, K., **Colliander, A.**, "Systematic Noise Analysis of a Correlation Radiometer Front-End", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2004, Anchorage, Alaska, USA, September 20-24, 2004
28. **Colliander, A.**, Tauriainen, S., Auer, T., Kainulainen, J., Uusitalo, J., Toikka, M., Hallikainen, M., "Calibration of Fully Polarimetric Noise Injection Radiometer of MIRAS", MicroRad 2004 - 8<sup>th</sup> Specialist Meeting on Microwave Radiometry and Remote Sensing for the Environment, Rome, Italy, February 24-27, 2004
29. **Colliander, A.**, Tauriainen, S., Auer, T., Kainulainen, J., Uusitalo, J., Toikka, M., Hallikainen, M., "Development and Characterisation of Fully Polarimetric Noise Injection Radiometer for MIRAS", IEEE International Geoscience and Remote Sensing Symposium IGARSS 2003, Toulouse, France, July 21-25 2003